KRUEGER
Excellence in Air Distribution

Krueger Proportional LineaHeat
W/ Discharge Temperature Limit

Start-Up, Operation and Service Instructions

SAFETY NOTE

Air-handling equipment will provide safe and reliable service when operated within design specifications. The equipment should be operated and serviced only by authorized personnel who have a thorough knowledge of system operation, safety devices, and emergency procedures. Good judgment should be used in applying any manufacturer's instructions to avoid injury to personnel or damage to equipment and property.

WARNING: Disconnect all power to the unit before performing maintenance or service. Unit may automatically start if power is not disconnected. Electrical shock and personal injury could result.

WARNING: Units with LineaHeat use Solid State relays, which generate heat when used. The temperature of the control box and/or heat sinks may be hot.

OVERVIEW

LineaHeat is an electronic, time proportional electric heat system. The heat output of the heater is modulated utilizing quiet, rapid performing solid state relays. The relays are switched off and on to allow the heating of electrical resistance elements. The proportion of time the relay is on dictates the proportion of maximum heat the electric heater can produce. The solid state relays are switched off and on by a supplied Electric Heat Module (EHM). The EHM accepts an input signal from the terminal unit controller or thermostat for the amount of heat desired. The EHM can accept a variety of different input signals when interfacing with controls. The type of input the EHM will accept is modified by changing the position of one or two jumpers easily accessible on the board.

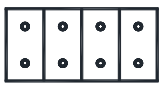
The LineaHeat is available with an optional discharge temperature sensor. When used with the discharge sensor option, the LineaHeat will modulate outgoing temperature from the unit between the maximum temperature setting and initial temperature of incoming air before heating began. The discharge temperature set point is easily adjusted in the field by rotating the temperature dial on the EHM. The EHM will not allow temperatures over the set point so as to prevent overheating, stratification, and energy waste from heated air lost through overhead returns.

START-UP

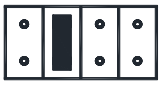
INPUT SETTING. The LineaHeat board is capable of being controlled and operated 7 different ways. The units are ordered with an LXY code, where "X" is coded for unit power and "Y" is coded for the application. This "Y" application can be changed in the field. The application desired is chosen by placement of jumpers in the corner of board (See Drawing 1 on page 2). Jumper settings below are representative of pins at bottom left of control board as shown in drawing. Wiring diagrams for each are on pages 5 & 6.

LX1) **On/Off:** This application accepts one 24 Vac input at "Inc" to step the heater output from OFF to 100% heater kW rating. The signal may be pulsed off and on over a small time period to provide proportional heat. For example, a signal that is on for 4.5 seconds every 10 seconds would produce 45% of the heater's kW rating.

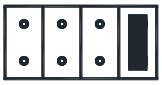
LX2) **2 Stage:** This application accepts two 24 Vac inputs at "Stage 1" and "Stage 2" to step the heater output from OFF to 100% heater kW rating. Each stage is used for controlling heat from 0 to 50%.



LX3) **0-10V:** This application accepts a 0-10 Vdc (0-20mA) signal to modulate the heater output. The output is proportional to input signal (i.e., 4.5 volts sets the heater to 45% of kW rating).



LX4) **2-10V:** This application accepts a 2-10 Vdc (4-20 mA) signal to modulate the heater output. The output is proportional to input voltage above 2 volts (i.e., 4.5 volts sets the heater to 25% of kW rating).



LX5) **Incremental (Incr):** This application accepts one 24 Vac input to modulate heater output. An increase signal will increase the heater output from 0% to 100% over a 4 minute 15 second interval, staying at 100% afterward. When the signal is removed, the heater output will decrease to 0% over the same time period. This application mirrors a Normally Closed hot water valve.

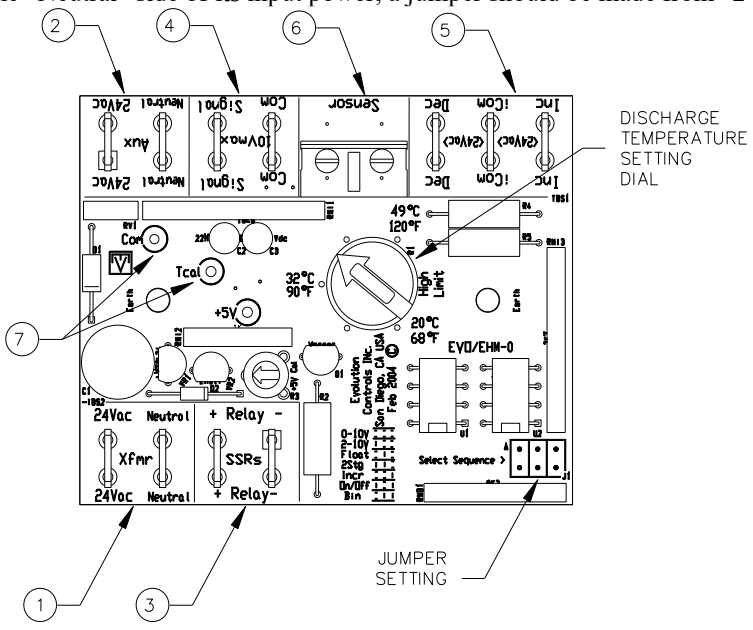
LX6) **Binary (Bin):** This application accepts two 24 Vac inputs to step the heater from off to 33%, 67%, or 100% of the heater's kW rating. A signal to "Inc" is 33%, a signal to "Dec" is 67%, and a signal to both is 100%.

LX7) **3 Point Floating (Float):** This floating input application accepts two 24 Vac inputs to increase or decrease the heater output. As the increase signal is sent, the heater output will increase from 0% to 100% over a 4 minute 15 second interval. If the increase signal is removed, or decrease signal is also added, the heater output will stay constant at present point. When only the decrease signal is received, the heater output will decline from the present level to 0% over the same time period. This application mirrors a Three-Point floating hot water valve.

WIRING. The EHM control board is powered by 24Vac **(1)** from the transformer in the electric heater. The EHM has auxiliary 24Vac outputs **(2)** that can be used to power the unit's electrical controls. Next to the "Xfmr" inputs are the "+" and "-" Relay connections **(3)** that control the solid state relays by sending pulses of ~25Vdc.

There are two terminations to use for dc Volt control **(4)** of the electric heat (applications LX3 and LX4 from above). These are polar sensitive. The "+" signal from the controller must be connected to "Signal" on the EHM Control Board. The "-" from the controller must be connected to "Com" next to "Signal (Note: NOT "iCom"). A termination to "-" is possible, but not necessary to measure mA signals to the board.

There are three terminations for 24 Vac control **(5)** of the electric heat (applications LX1, LX2, LX5, LX6, and LX7 from above). "Inc" is for the increase signal in applications LX5 and LX7, as well as the first stage heat signal in applications LX1, LX2, and LX6. "Dec" is for the decrease signal in application LX7**,** as well as the second stage heat signal in applications LX2 and LX6. A connection to "iCom" is necessary for all of these 24 Vac applications. If the unit's controller does not have a Common output, a jumper to the correct "Aux" terminal can be used. If the unit controller outputs the "24Vac" side from it's input power, a jumper should be made from "Neutral" to "iCom" (See sample diagram on page 7). If the unit controller outputs the "Neutral" side of its input power, a jumper should be made from "24Vac" to "iCom".



DISCHARGE TEMPERATURE SET POINT. LineaHeat comes with a discharge temperature set point (DTS) option. This option allows a maximum temperature to be set at the board to prevent overheating of discharge air. When the unit receives a signal to start heating, the board will take an initial temperature reading and modulate heat from that point to the maximum temperature. For example, if a thermostat requires only a 10% heating output of air that was initially 60°F and has a maximum temperature setting of 90°F, the EHM will modulate the heater's output temperature to 63°F (the additional 3 degrees coming from (90-60)*10%). This allows heaters to be sized for morning warm up in the winter and still comfortably operate on those days when the inlet temperatures are slightly warmer.

The discharge temperature sensor comes with a 9' cable for mounting in the downstream ductwork. The sensor should be mounted a minimum of 36" from the discharge of the unit and centered in the side of the ductwork. Avoid installing the sensor near an elbow, take off or transition. The sensor can be mounted by drilling a 1/2" hole into the ductwork, inserting the sensor, and securing it with 2 sheet metal screws. The sensor is 6" long, and the tip should not touch any part of the ductwork.

Neither the jumper settings nor the controls wiring needs to be changed when this option is ordered. The EHM control board will detect if a sensor has been connected, and it will adjust the control function accordingly. The sensor wires are connected to the screw terminals at the "Sensor" **(6)** location on the EHM. The connection at this termination is not polar sensitive and the two wires may be switched with no effect.

The desired discharge temperature is set by rotating the discharge temperature set point dial arrow to the maximum outlet temperature desired. To fine tune the discharge temperature set point, connect the positive and negative leads of a multimeter to "Tcal" and "Com" **(7)**, respectively, on the EHM. Then place a jumper between the two screw heads on the sensor termination. Rotate the discharge temperature set point dial until the desired voltage per temperature is obtained. After the voltage is obtained, the EHM board must be reset. To reset the board, remove the jumpers and then place back in correct position.

TEMP	dc VOLT	TEMP	dc VOLT	TEMP	dc VOLT	TEMP	dc VOLT	TEMP	dc VOLT
68	0.00	80	0.58	90	0.95	100	1.23	110	1.44
69	0.05	81	0.62	91	0.98	101	1.25	111	1.46
70	0.10	82	0.66	92	1.01	102	1.27	112	1.48
71	0.15	83	0.70	93	1.04	103	1.30	113	1.50
72	0.20	84	0.74	94	1.07	104	1.32	114	1.51
73	0.26	85	0.77	95	1.10	105	1.34	115	1.53
74	0.30	86	0.81	96	1.12	106	1.36	116	1.55
75	0.35	87	0.85	97	1.15	107	1.38	117	1.56
76	0.40	88	0.88	98	1.18	108	1.40	118	1.58
77	0.44	89	0.91	99	1.20	109	1.42	119	1.60
78	0.49							120	1.61
79	0.53								

It should be noted that ASHRAE Fundamentals Handbook (Chapter 31) states that discharging air at a temperature more than 15°F above the room (90°F in a 75°F room) will likely result in significant unwanted air temperature stratification.

It is recommended that heater output is ramped or staged when switching from cooling to heating modes. On initial call for maximum or near maximum heat, from cooling mode, the heater may overshoot the desired temperature by up to 20°F for 10 to 20 seconds (on oversized heaters). As the EHM begins modulating heater output, the discharge temperature will quickly drop to the desired set point. Temperatures within ±2°F of desired set point are reached within 90 seconds with oversized heaters.

TROUBLESHOOTING

Problem: No Heat when called for.

1) Confirm the jumper setting is correct for the input given.
   a) If the controls are outputting Vdc, the jumper should be set as shown on page 1 for applications LX3**,** and LX4.
   b) If the controls are outputting 24Vac, the jumper setting should be set as shown on pages 1 & 2 for applications LX1, LX2, LX5, LX6, & LX7. (Also see diagrams on page 6 & 7)

2) Check that wiring to the EHM is correct.
   a) If using applications LX3 and LX4, confirm the positive Vdc connection is wired to the "Signal" terminal, and the negative Vdc connection is wired to the "Com" terminal.
   b) If using 24Vac, confirm the wires are terminated correctly at **(5)** with a connection at "iCom"**.** If an "Aux" terminal **(2)** on the EHM has been jumpered to "iCom", make sure that the opposite 24Vac input is what is outputted at the controls (See page 7 for one example).

3) Check that airflow is above minimum. Terminal units with electric heat come with pressure switches to insure that heater elements have airflow over them. See catalog for minimum airflow required for specific size terminal units. The recommended minimum downstream static pressure is 0.1" to ensure stable operation of the airflow switch.

4) Check that discharge temperature setpoint is not below the airflow temperature.

5) Check Relay wiring. Solid state relays are polarity sensitive. The wire from "+" on the EHM control board should be terminated on "+3" VDC terminal of the relay. The wire from "-" on the EHM control board should be terminated on "4-" VDC terminal of the relay. If there are two relays used in the heater, the relays are daisy chained from "4-" to "+3" together (See page 7 for one example).

Problem: Discharge Temperature not at Temperature Setting.

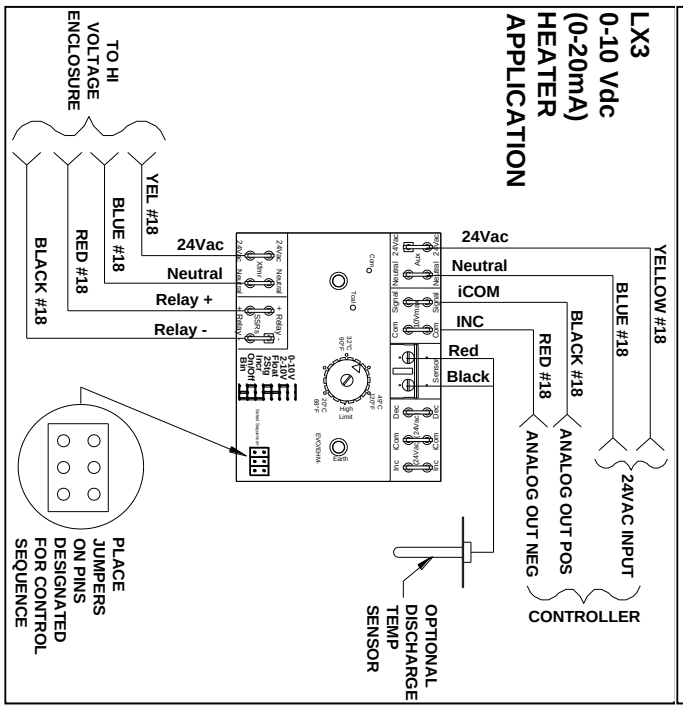
1) Check that wires from sensor are stripped and terminated in EHM control terminals.

2) Check that wires from controls are terminated at the correct point on EHM board. Increase or stage 1 signal should be terminated at "Inc". Decrease or stage 2 signal should be terminated at "Dec".

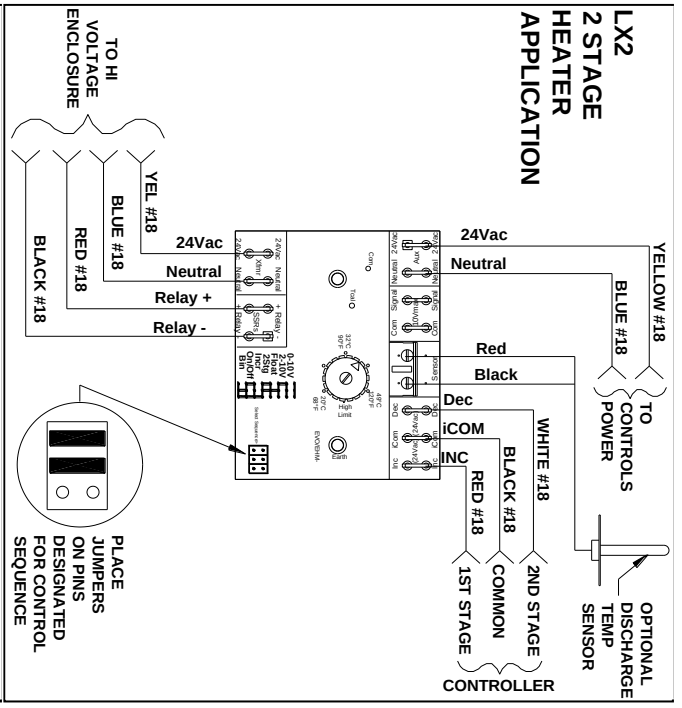
3) Check volt setting. Use chart and procedure on page 3.

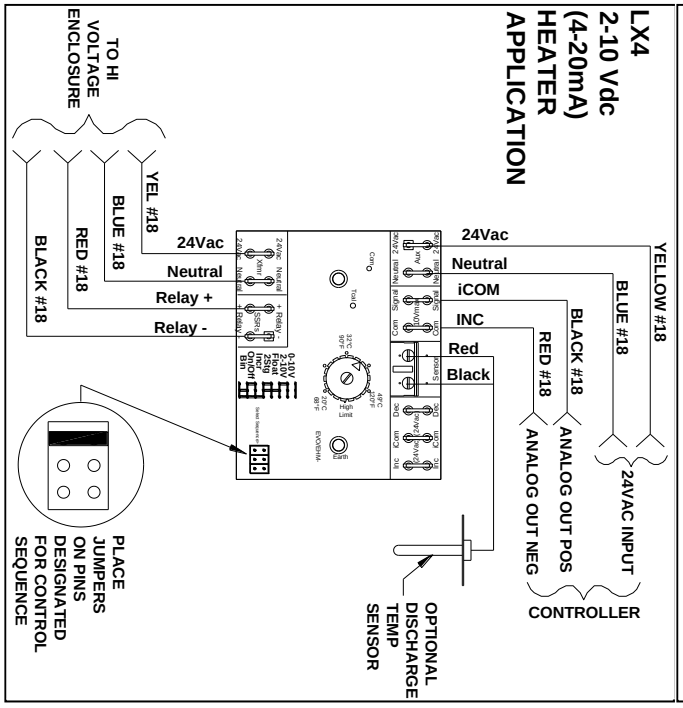
4) Check sensor placement. Make sure that sensor is well placed in the side of the duct vertically centered and at least 36" from discharge. Sensor tip should not touch inside of ductwork. If available, remove the discharge sensor and measure the temperature of the air using a temperature probe and compare it to an average reading of the discharge air of the diffusers in that zone. If the sensor is located near an elbow, duct take off, or transition, several locations may need to be tested to find a location that provides an accurate reading.

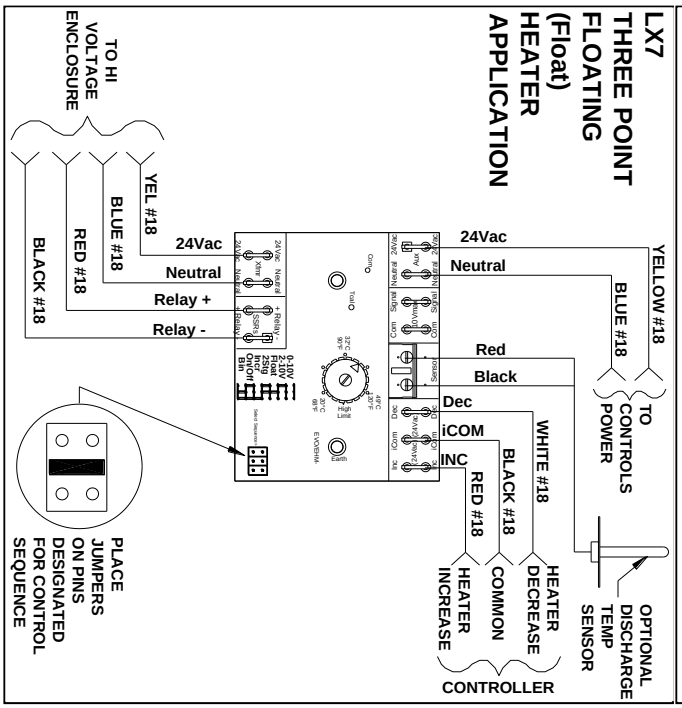
5) Try staging or ramping of output on oversized heaters. When controls call for full heat from cooling mode, if heaters are too large and heating times are small, the heater output may be over setpoint. Staging or ramping of output over a 60 second interval will provide smooth transition. If only one output of heat is available from controls, application LX5 will proportionally ramp heat output from 0 to 100% over a 4 minute 15 second span.

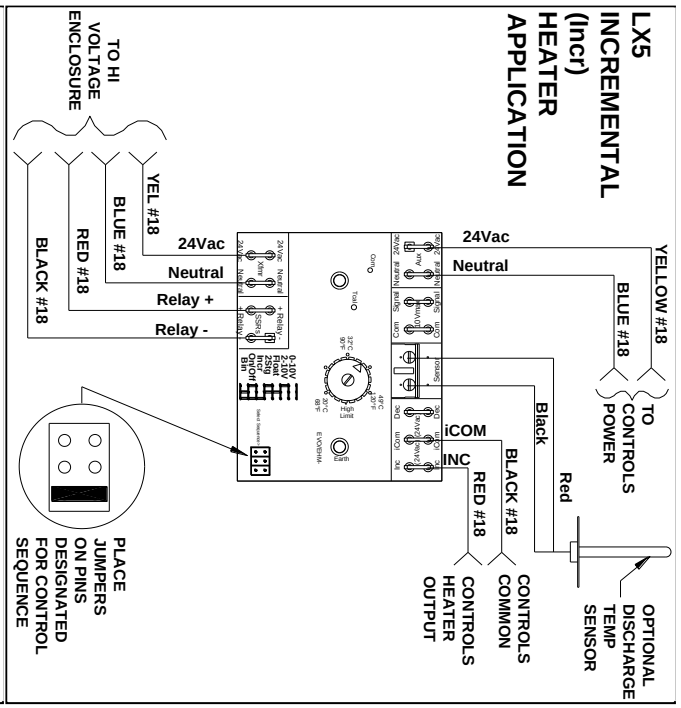

LX1
ON/OFF
HEATER
APPLICATION
YELLOW #18
BLUE #18
TO
CONTROLS
POWER
24Vac
Neutral
Red
Black
OPTIONAL
DISCHARGE
TEMP
SENSOR
iCOM
INC
BLACK #18
RED #18
CONTROLS
COMMON
CONTROLS
HEATER
OUTPUT
TO HI
VOLTAGE
ENCLOSURE
YEL #18
BLUE #18
RED #18
BLACK #18
24Vac
Neutral
Relay +
Relay -
PLACE
JUMPERS
ON PINS
DESIGNATED
FOR CONTROL
SEQUENCE

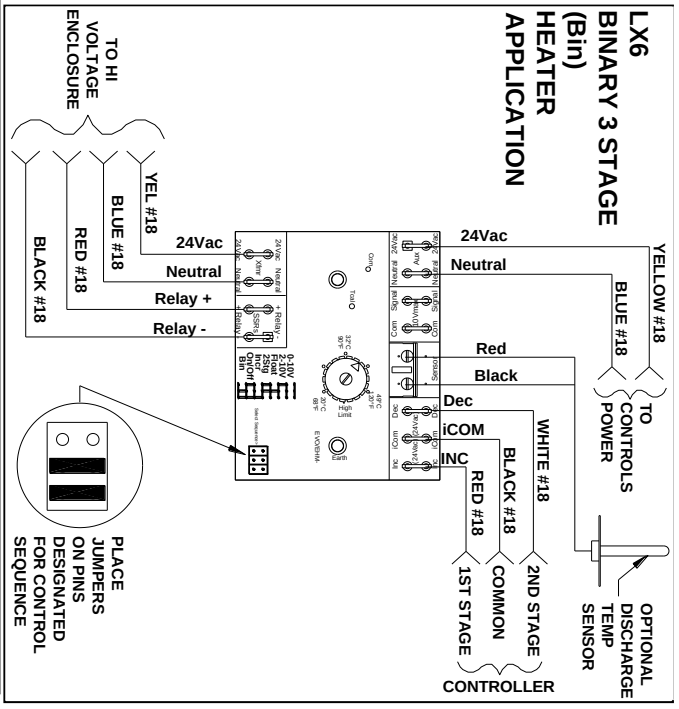
LX3
0-10 Vdc
(0-20mA)
HEATER
APPLICATION
YELLOW #18
BLUE #18
24VAC INPUT
24Vac
Neutral
iCOM
INC
Red
Black
BLACK #18
RED #18
ANALOG OUT POS
ANALOG OUT NEG
CONTROLLER
OPTIONAL
DISCHARGE
TEMP
SENSOR
TO HI
VOLTAGE
ENCLOSURE
YEL #18
BLUE #18
RED #18
BLACK #18
24Vac
Neutral
Relay +
Relay -
PLACE
JUMPERS
ON PINS
DESIGNATED
FOR CONTROL
SEQUENCE

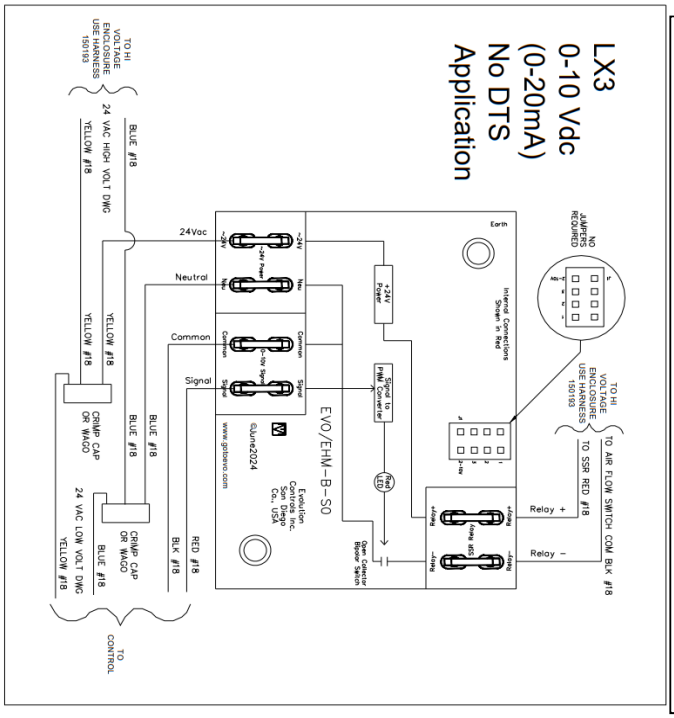

LX2
2 STAGE
HEATER
APPLICATION
YELLOW #18
BLUE #18
TO
CONTROLS
POWER
24Vac
Neutral
Red
Black
Dec
iCOM
INC
WHITE #18
BLACK #18
RED #18
2ND STAGE
COMMON
1ST STAGE
CONTROLLER
OPTIONAL
DISCHARGE
TEMP
SENSOR
TO HI
VOLTAGE
ENCLOSURE
YEL #18
BLUE #18
RED #18
BLACK #18
24Vac
Neutral
Relay +
Relay -
PLACE
JUMPERS
ON PINS
DESIGNATED
FOR CONTROL
SEQUENCE

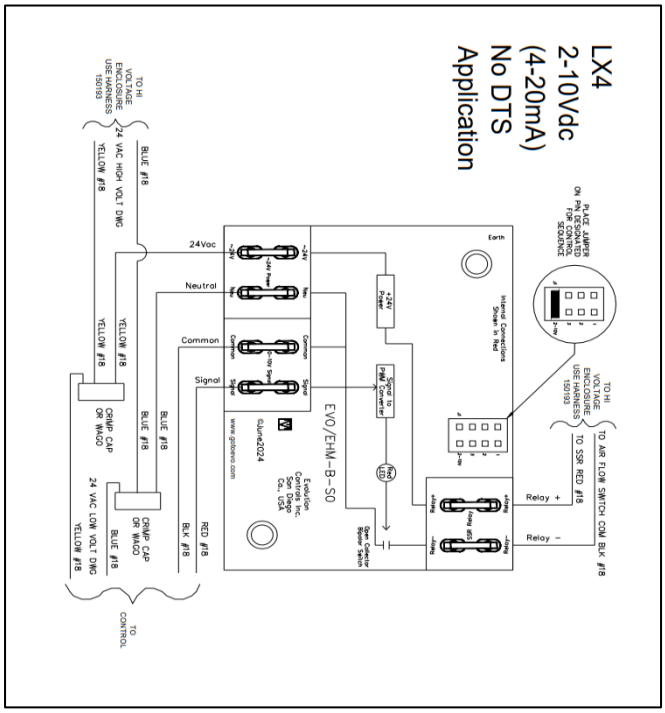

LX4
2-10 Vdc
(4-20mA)
HEATER
APPLICATION
YELLOW #18
BLUE #18
24VAC INPUT
24Vac
Neutral
iCOM
INC
Red
Black
BLACK #18
RED #18
ANALOG OUT POS
ANALOG OUT NEG
CONTROLLER
OPTIONAL
DISCHARGE
TEMP
SENSOR
TO HI
VOLTAGE
ENCLOSURE
YEL #18
BLUE #18
RED #18
BLACK #18
24Vac
Neutral
Relay +
Relay -
PLACE
JUMPERS
ON PINS
DESIGNATED
FOR CONTROL
SEQUENCE


LX7
THREE POINT
FLOATING
(Float)
HEATER
APPLICATION
TO HI
VOLTAGE
ENCLOSURE
YEL #18
BLUE #18
RED #18
BLACK #18
24Vac
Neutral
Relay +
Relay -
YELLOW #18
BLUE #18
TO
CONTROLS
POWER
Red
Black
Dec
iCOM
INC
WHITE #18
BLACK #18
RED #18
HEATER
INCREASE
COMMON
HEATER
DECREASE
CONTROLLER
OPTIONAL
DISCHARGE
TEMP
SENSOR
PLACE
JUMPERS
ON PINS
DESIGNATED
FOR CONTROL
SEQUENCE

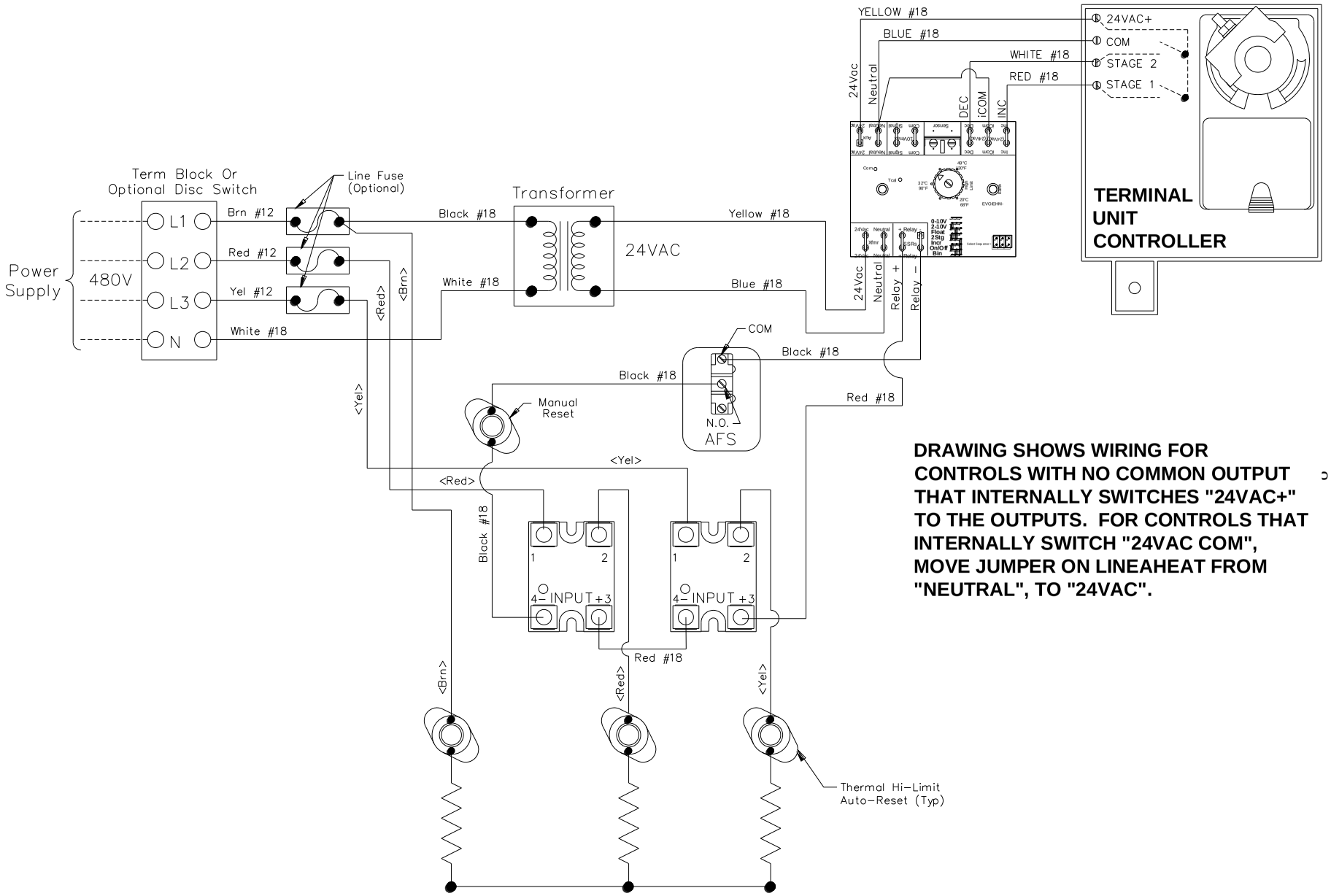

LX5
INCREMENTAL
(Incr)
HEATER
APPLICATION
TO HI
VOLTAGE
ENCLOSURE
YEL #18
BLUE #18
RED #18
BLACK #18
24Vac
Neutral
Relay +
Relay -
YELLOW #18
BLUE #18
TO
CONTROLS
POWER
Red
Black
iCOM
INC
BLACK #18
RED #18
CONTROLS
HEATER
OUTPUT
CONTROLS
COMMON
OPTIONAL
DISCHARGE
TEMP
SENSOR
PLACE
JUMPERS
ON PINS
DESIGNATED
FOR CONTROL
SEQUENCE


LX6
BINARY 3 STAGE
(Bin)
HEATER
APPLICATION
TO HI
VOLTAGE
ENCLOSURE
YEL #18
BLUE #18
RED #18
BLACK #18
24Vac
Neutral
Relay +
Relay -
YELLOW #18
BLUE #18
TO
CONTROLS
POWER
Red
Black
Dec
iCOM
INC
WHITE #18
BLACK #18
RED #18
2ND STAGE
COMMON
1ST STAGE
CONTROLLER
OPTIONAL
DISCHARGE
TEMP
SENSOR
PLACE
JUMPERS
ON PINS
DESIGNATED
FOR CONTROL
SEQUENCE


LX3
0-10 Vdc
(0-20mA)
No DTS
Application
TO HI
VOLTAGE
ENCLOSURE
USE HARNESS
19D193
24 VAC HIGH VOLT DWG
BLUE #18
YELLOW #18
24Vac
Neutral
Common
Signal
EVO/EHM-B-S0
Earth
NO
JUMPERS
REQUIRED
Internal Connections
Shown in Red
TO AIR FLOW SWITCH COM BLK #18
Relay +
Relay –
CRIMP CAP
OR WAGO
24 VAC LOW VOLT DWG
TO
CONTROL


LX4
2-10Vdc
(4-20mA)
No DTS
Application
EVO/EHM-B-SO
Earth
24Vac
Neutral
Common
Signal
Relay +
Relay –
TO AIR FLOW SWITCH COM BLK #18
TO SSR RED #18
BLUE #18
YELLOW #18
RED #18
BLK #18
CRIMP CAP OR WAGO
24 VAC HIGH VOLT DWG
24 VAC LOW VOLT DWG
TO CONTROL

Form No. LHOM-2 5/25



DRAWING SHOWS WIRING FOR CONTROLS WITH NO COMMON OUTPUT THAT INTERNALLY SWITCHES "24VAC+" TO THE OUTPUTS. FOR CONTROLS THAT INTERNALLY SWITCH "24VAC COM", MOVE JUMPER ON LINEAHEAT FROM "NEUTRAL", TO "24VAC".

SAMPLE LINEAHEAT SCHEMATIC